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IMPROVED DROP HAMMER.

A volume might be written upon the hammer and its uses. The historian, if adhering to the Scriptural tradition, would doubtless begin with the labors of Tubal Cain. In the days before the flood; or, if inclined to Darwinism, with the probable efforts of our wisest ancestors to break the thick scabbard of the cocoon by pounding it with stones in order to reach the food within; or, if non-committal to either belief, like opening sentences would tell of the stone implements of the cave dwellers (inhabitants of the world ages ago) which now are found mingled with the bones of strange creatures long since passed from the face of the earth. Tracing the history of the hammer from the rude pebble of the barbarian, through the ages of stone and iron, up to the present day, he would find in its use a necessity in every trade, its forms of infinite variety, extending from the flint implement of the jeweler, barely a fraction of an ounce in weight, to the colossal mass of a hundred tons of solid metal, delivering its blows with almost terrific might.

It is to the worker a machine that the hammer is the most important of tools, and it may be interesting, especially in connection with the subject of this article, briefly to note the adaptations of the implement to meet the requirements of the forge. The head sledge, owing to the powerful arms of the smith, no longer able to cope with the increasing size of the work to be fashioned, gave place to the apparatus driven by machinery.

The most ancient form of drop hammer is probably the tenant beise, known in France as the *marotte*, a heavy mass of cast iron, lifted by projecting arms fixed in a cam ring and falling through a certain space by its own gravity. Thus came the tilt hammer, which, instead of being raised at the front end, was depressed by a cam ring from a part projecting behind. Another improvement on the original tenant beise was to lift the beise between the head of the hammer and the pivots on which it works. The last innovation, and the one which has remained longest in use, is the belly beise, which is raised under the bottom part of the beise by means of a lamp, which could be lengthened or shortened according to the size of the piece to be acted upon. After all appeared the steam hammer in their various forms, possessing adaptability to the future extent of which no limit can be set. With these, however, we have not now to deal: for it is our object, at present, to refer simply to efforts made to drive hammers in connection with rollers, and not by the direct application of the source of power to the implements themselves. While the steam hammer is susceptible to a great variety of uses, there are circumstances under which a device of the first mentioned class may serve certain purposes with even better

results, while in other respects the latter may be sufficiently efficient to meet all requirements. As a particular instance of this, we take occasion, in the following description, to direct attention to a new machine for the making of forgings by a single blow, by forcing the metal into suitable dies. Hammers, both hand and power, have been always used for

steam hammer, and indeed is every now employed, seems to be less of power by gearing, trouble in regulating pressure or adapting it to work required, and the fact that the head, moving as it does in the arc of a circle, does not, on thick metal, strike a direct blow.

A glance at the engraving of the machine herewith presented will at once demonstrate that two of the disadvantages above cited are absent, namely, the complicated gearing and the indirect stroke; and the following explanation will show that the force and extent of the blow can be governed with the utmost certainty and ease.

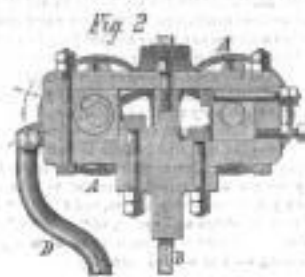
The heavy hammer head, which is constructed to weigh from 300 to 1,500 lbs., travels between two uprights and to it is attached a board of white oak or other suitable wood, which passes between two smooth friction rolls located in the upper portion of the machine. These rolls revolve in opposite directions, and each is driven by a separate pulley from one driving shaft, with cross and open belts. When they are closed together and pressed against the board, their friction upon each side of the latter raises it, and thus elevates the hammer; then, when the rolls are separated, the head is free to fall by its own gravity. The mechanism by which the operation is effected will be understood from the sectional view, Fig. 2, in which A A are the rolls, and B the board between them.

The shaft upon which the front roll is keyed, runs in eccentric sleeves, one of which is shown at C, which are placed in stationary boxes. Hence, when these sleeves are rotated a small portion of a circle, the front roll is moved nearer to or further from the rear roll. To the arms of the sleeve is attached a drop rod, D, which connects with a lever,

and the latter with a treadle. We will suppose the hammer to be at the upper portion of the frame and to rest upon the latch shown at the right. This latch, it will be seen, is adjustable, and may be pivoted at any elevation, and is connected with the treadle bar. When the workman presses the treadle down with his foot, he raises the drop rod, D, and, as is evident, at the same time pulls back the latch. Raising the drop rod causes a separation of the rolls; and the latch also being removed, the hammer, being unsupported, falls. At that instant, the blow being delivered, the operator removes his foot from the treadle, the drop rod then falls, and the eccentric sleeves turning the front roll, aided by the pull of the belt, is forced against the board, raising the hammer up again. If it be desired to give a series of heavy blows, the latch is thrown back out of operation and the hammer allowed to rise until it strikes a projection upon the drop rod; this it impinges against and rises, and so lifts the rod, causing, as we have shown, a separation of the rolls. The position of the projection on the drop rod is such that the latter will be lifted by the upper surface of the head when the hammer rests upon the latch, so that the machine may

MERRILL'S IMPROVED DROP HAMMER.

thus molding plates of metal, and one of the best known mechanical forms is the Oliver, an apparatus governed by the action of a spring pole controlled by the feet of the workman. The difficulty, however, with the large majority of the old implements is one proceeding from the introduction of the



be left thus set, the rolls not gripping the board until the rod is lifted by the handle. The hammer, as a moment's consideration will show, follows the motion of the foot, and blows of any degree of sharpness or lightness may be delivered. It may be instantly arrested at any point of its stroke, by simply removing the foot from the treadle, and thus ceased to rise without delivering its blow. In a word, the machine is under complete control of the operator and is managed with perfect facility. In order to compensate for the gradual wearing down of the plank, the movable bar, in which the rear friction pulley has its bearing, is provided with two screw bolts, one above the other, the lower one, only, to be in use. After loosening the upper screw bolt, the lower one can be turned in, thus pushing the bar closer up to the board. Then, by tightening the upper bolt again, the bar is rigidly secured in place.

As we stated in the outset, although the apparatus is excellently suitable for any variety of forging, it is especially adapted, by reason of its quick sharp blow and the means provided of instantly catching the hammer and preventing rebound, for the making of drop forgings. The articles which can thus be formed by the aid of this are remarkably numerous; and when this simple and quick mode of producing them is considered in connection with the labor of casting or cutting them from the metal, the economy is obvious. Numbers of articles, such as wrenches, sockets, set screws, rings, bolts, hooks, and small portions of machinery, are thus instantly and accurately stamped out, requiring but a little finishing to complete them. The metal is heated and placed in the lower die, but not in such a quantity as to fill the same. As the drop falls, the blow forces the material into all the recesses of the mold, of which the exact shape is reproduced. We would remark here that it is quite common to place the hot metal above the die and drive it down, doubling it up, so to speak. The result of this is that the air in the die is tremendously compressed and forces its way out, scoring the cast steel of the lower strand as sharply as if done with a file. Again, but a single blow should be delivered, as the first stroke usually spreads out a thin sheet of metal, on the surface of the die, which rapidly cools. If this be struck by the hammer, not only will the forging be thrown out of shape, but the die itself is liable to injury.

The uses to which this invention may be put need no further explanation, as to the practical mechanic its advantages will be clearly apparent. Its operation is simple and within the comprehension of the most ordinary workman, and the materials used are strong and durable. A board will last several months and may be readily replaced at trifling expense. The manufacturer informs us that a large demand for the machine has already sprung up. The Prussian government, through Messrs. Pratt and Whitney, have already ordered thirty machines, and others have been shipped directly to the Spanish and Turkish governments; the Baldwin Locomotive Works employ five, and the Providence Tool Company twenty-five, while some 180 hammers have been in all made during the past two years. For further particulars address Messrs. Charles Merrill & Sons, No. 536 Grand street, New York city.

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BOILER EXPLOSIONS NO MYSTERY.

We had the pleasure, recently, of listening to a lecture by Mr. McMurtrie on the subject of steam boiler explosions, delivered before the Polytechnic Club of the American Institute.

The speaker is a well known citizen of Boston, an engineer by profession, and formerly of the United States Naval Engineering Corps. He is one of the working friends of the Mass-

achusetts Institute of Technology, and is considered, by the members of his profession, to be one of its ablest representatives.

The lecturer gave a succinct and very intelligent account of the principal of the many known causes of explosions, showing that they were all very simple and very easily understood, and that the mystery of steam boiler explosions arose merely from a difficulty in determining from the scanty and usually conflicting evidence presented, to which of the known causes the disaster should be ascribed, rather than from the existence of any mystery in the nature of the cause itself.

It was stated that, out of thousands of cases of explosions which had been examined by experts, but a limited number, which might be counted on the ends of the fingers, were still involved in uncertainty as to cause; and even in these cases, the evident difficulty was insufficiency of testimony.

Neglect of boilers which required repair, ignorance of the proper methods of management, defective safety valves and other appliances, and the innumerable other causes arising from gross failure in those having boilers in charge, were shown to be invariably chargeable with the terrible loss of life and property annually produced by explosions.

The character of these several classes of defects in the boilers themselves, and in their management, was plainly shown to be easily comprehended by average intelligence, and the fact was impressed upon the audience that in no case was the phenomenon involved in mystery. In every example, where it had been possible to obtain reliable evidence, it had been found that the cause was readily ascertainable; and it was also found that the cause, when determined, was perfectly simple and readily comprehended by any well informed person.

It was shown that, in all cases where there existed any apparent mystery, it had been found that evidence was lacking, and that, were the disaster due to well known causes, no reliable testimony was obtainable to reveal it.

It was therefore concluded that, whenever one of these and "accidents" occurs, it is the duty of those charged with its investigation to take the fact to be prima facie evidence of the criminality of some one, and to devote their attention to the detection of the criminal.

If there appears to exist no evidence revealing wrong doing, and although the testimony presented may seem to preclude the assignment of any known and probable cause, it is still to be concluded that the mystery does not attach to the cause of the accident itself, but to those causes which conspire to hide its origin. The greatest apparent mystery is often found, after long and almost discouraging investigation, to be explainable by absurdly simple trains of circumstances.

The lecturer occupied an hour in the delivery and was listened to by the crowded audience with a degree of attention which showed very plainly that the subject was one of public interest.

In the discussion which followed, Mr. Montgomery, the well known engineer and inventor, referred to the phenomena of electrical action, of "farrowing" or "grooving" and the formation of "mysterious" cylinders within the boiler by the opening of the safety valves, and presented them as examples of still unexplained mysteries.

Other gentlemen insisted that the distinction between the bursting and the explosion of steam boilers had been overlooked, and urged that the latter was produced by some still unknown cause, since no known phenomenon could possibly be the cause of such tremendous violence as frequently characterized explosions.

The chairman called up Professor Thurston, who was present, and, complying with the request, the latter explained the several apparent mysteries. Electrical action was considered to be a cause of some cases of exceptionally rapid corrosion, and to act in a greater or less degree in all cases. It was stated that the slightest difference, whether chemical or physical, between different parts of the boiler, causes the formation of what electricians call "local circuits" and the acceleration of oxidation. It is even supposed that all corrosion is due to electrical action, and the less rapid oxidation (which is noticed when surfaces are most perfectly uniform in character, as, for example, when zinc is amalgamated) is simply a consequence of the reduction of voltaic action by lessening the number and the intensity of action of local circuits.

Farrowing and grooving, which occur so frequently and to so serious an extent along the lap, and adjacent to lines of exceptional stiffness throughout the shell of locomotive and other boilers, was shown to be the evident result of long continued and frequently repeated bending (along lines of weakness where the action is concentrated by the stiffness of the adjacent seams), this change of form being a consequence of the continually occurring variations of pressure and temperature of steam and changes in the water level, which naturally produce considerable alteration in the shape of a flexible structure as a boiler shell of quarter or three eighths metal, loaded with tons of water and subjected to variations of internal pressure amounting to hundreds of tons.

A statement of the almost obvious, yet seldom recognized, fact that steam, issuing from an open safety valve, poses ten times the velocity of the heaviest hurricanes known among the West Indies or in the Chinese seas, and that the pressure of the wind in a real cyclone is but a fraction of a pound per square inch, showed that cyclones in a boiler, when the safety valves were raised, were not to be analogized among the mysteries of steam boilers, and that the "entailment" of mingled steam and water, or "priming," even to the extent of emptying the boiler, were no more mysterious than the boiling over of a tea kettle.

The apparently mysterious phenomenon which the French call a "droning explosion," with its fearful power and disastrous effects, was shown to be perfectly free from all mystery by a simple calculation of the amount of energy pent up in the steam boiler which was exploded by Mr. F. E. Stevens at Sandy Hook. Had it all been expended in raising the whole boiler directly upward, without waste in other directions, this confined force would have raised the mass to the tremendous height of five miles. The mystery, if any exists, is therefore that such explosions are not usually far more terrible than they actually are.

Finally, a short explanation was given of the nature of the "internal strain," as it is called, which is so common a cause of weakness in large masses of cast iron, and which seriously affects large pieces of steel, and even of malleable iron. The bearing of the recent discoveries and investigations of the speaker upon the existing theory of rupture was briefly given, and the conclusion was drawn that the greatest care should be taken to select the purest and most ductile iron, wherever changes of form and dimensions, such as had been described, were to be met. We have obtained a short description of the process of rupture, as it was given by the speaker, and give it to our readers in another column in his own words.

The last speaker, in commenting, stated that, although it will remain uncertain how far some causes, which were suspected to operate in exceptional cases, were to be credited with the production of observed facts, he was inclined to class all causes thus: First, ignorance; second, carelessness; third, sheer recklessness; and the readers of the SCIENTIFIC AMERICAN who have followed the many discussions of such cases which have appeared in our columns will be very apt to accept this classification.

Such discussions as that above described cannot fail to do much good; and it is to be hoped that they will aid in educating the public so effectively that consumers' juries will become convinced that verdicts of "no one to blame," "unknown cause," and similar expressions of ignorance, will only exhibit their own neglect of duty or lack of intelligence.

Our neighbors of the Tribune should secure such lectures as the above for their "extra." They would be hardly less interesting, and would be even more useful to the world, than the more brilliant but less practical essays which are so eagerly asked upon to fill these pages.

THE HUDSON RIVER AND LAKE CHAMPLAIN SHIP CANAL.

On another page of this issue will be found a description, illustrated by a map, explaining the scheme now before the Legislature of New York, for the construction of a navigable water way between Troy and Lake Champlain. The work, it will be seen, includes the deepening of the Hudson River from Troy to Fort Edward, and the excavation of a canal from the latter point to White Hall on the lake, the entire length of the improvement being sixty-three and three tenths miles. The advantages to be gained by the work are of such immense importance that its cost is rendered a matter almost insignificant. By an outlay of a sum which at the highest is estimated at \$20,000,000, water communication from the Missouri and Mississippi rivers, and from all the ports and navigable inlets of the great lakes, to the water at the cities of Troy, Albany, and New York, for vessels of a burden up to 2,000 tons, is to be secured.

In view of the strenuous endeavors which are being made by Boston, Philadelphia, and other cities of the Atlantic seaboard to bring to their markets the enormous commerce of the West and Northwest, the necessity which exists for the people of New York, and more especially of the metropolis, to put forth counter efforts to maintain the most feasible high-ways through their own State is becoming more and more apparent. Boston, by her recent railroad connections, claims to have gained, over the Erie canal, six days in time from Chicago and fifty per cent of transportation; while it is a fact that the grain receipts of the city have tripled during the past three years. Burlington within ten years has risen to a position to rival Albany in her great lumber trade. On the other hand, the Controller of this State in a late report shows that New York does not keep pace with the commerce of the West, and that the ratio of increase of tonnage is far from what it should be.

We need not refer to the high cost of transportation of western produce per railroad, or the immense waste of crops, which has taken place during several years past, owing to the inability of the present facilities to carry off the excess. No facts, we believe, are more generally understood. Hence it is certain that, not as a rival, but as an addition, to the Erie canal and other great high-ways now taxed beyond their limit, some other great outlet must be opened. We cannot have too many such, and their construction will be forced by the constantly increasing amount of western productions which must find markets in the East, we believe to be only a question of time; while the State first in the field to offer the best facilities will find, in the great commercial augmentation of its commerce and revenues, the richest rewards for the enterprise.

The work contemplated, in the bill before the Legislature, is nothing either in point of labor, time, and expense, beside the construction of the Erie canal. It could be entirely completed, it is stated, within four years; and estimating the transportation carried over it for the next twenty years at five million tons per annum, a toll of forty cents per ton would within a decade repay its entire cost. The latter is within the means of many individual citizens of the State, and when distributed by taxation would be scarcely felt. It is small enough for the merchants of New York city to raise it by subscription, a project which appears worthy of consideration.

en, if another session of the Legislature pass by and no provision be made for initiating operations.

We would bespeak for the details of the plan, which we take from the able speech of Hon. Smith M. Weed, member of assembly from Clinton county, N. Y., the careful examination of all our readers. It is certain that no great work of internal improvement is now contemplated, which is of more pressing importance, not merely to the metropolis of the State of New York, but to the vast section of the country whose commercial needs it must so materially meet.

CHAMELEON.

There is a curious little lizard, the name of which is so coupled with fable that many believe it has never even existed. We mean the chameleon, which, though never seen on this continent, abounds in the old world. It is generally imagined that the reptile is capable of changing its color at will to the brightest of rainbow hues, and there is a wide spread popular belief that it lives on air, both of which ideas, though naturally arising from the peculiar appearance and habits of the animal, are far from the truth. Some years since, we captured a pair of these lizards among some ruins in Asia Minor; and for the three months during which they lived very comfortably in a wooden building, we were enabled to study their strange peculiarities, and notably the phenomena for which M. Paul Bert, a member of the French Biological Society, has recently suggested some interesting explanations, which to us seem more in accordance with appearance than any yet advanced. The chameleon measures from five to eight inches in length and has a curious pyramidal shaped head, apparently separated from the neck. Its body is short and thick and ends in a prehensile tail of median length. The ears are concealed under the skin, the mouth is large, and the eyes, which are very prominent and fall, are closely covered by a scum-like lid in which is a small round perforation just in front of the pupil. The legs are long and slender, and terminate in a hand formed of five toes, divided into two bundles so as to resemble one broad finger and a thumb. By the aid of these members, and by winding their tails around the branches, the lizards climb about shrubs and trees in search of insects. Their motions are, however, very slow, and their habits sluggish in the extreme. They will cling to bare of their eyes for days at a time, giving out the slightest sign of life, except perhaps the occasional twinkle of eye. Handling them does not seem to disturb their equanimity, as they rarely struggle as long as they are permitted to cling to a finger, while they are perfectly harmless.

The strange peculiarity of the animal, however, is its faculty of changing its color, not in bright tints, but from a pale gray to light green, yellow, brown, reddish and violet shades, all, however, dusky and unobtrusive. These changes sometimes occur very rapidly and are apparently provoked by anger and fear. In handling the lizard, we have noticed that, although it would, as we have already intimated, show no symptoms of uneasiness, the clear light that shone over its whole body would give place to dark brown blotches, some of which shaded curiously into black, resembling in form the spots of a leopard. The cause of the phenomenon has generally been considered to be soft granules, under the skin and of different colors, which are more or less extended according to the quantity of blood which reaches them; but the recent investigations of M. Bert show clearly that the nervous system acts directly without the intermediation of the blood. If the arteries of a member be tied so that no blood can pass, and the nerve affected, the coloration still continues; while on the other hand, if the nerve be destroyed, the tissues assume a black tint from which they do not change. It is very probable that the nerves thus acting are of the same order as the vaso-motors: for when the animal is poisoned by curare, and the other nerves are consequently paralyzed in their functions, it at once becomes black. If the static nerve be identified in a thickness at which the nerves of color should exist, the muscles do not contract but the tint of the member changes, proving that the current acts separately on the color nerves. The action of the latter also permits exactly as does that of the vaso-motors in spite of the curare poison. The microscope shows tubercles beneath the skin, which become differently colored through the singular bodies, of which they are composed, contracting or expanding as governed by the nerves.

Another curious feature of the chameleon is the independence of its eyes. It moves them separately, and when the animal sleeps, it seems as if but one half of it were awakened at a time. If a light be placed before one eye, the half of the corresponding side of the body becomes of a different color from the other side; but the tint becomes uniform all over when the light is carried before the other organ. It would seem from this that the reptile has two distinct luminous perceptions.

So sluggish a creature, it might be supposed, would be hardly suited for catching insects, and such indeed would be the case were chasing the latter the only way of snatching them. The chameleon, however, resorts to strategy, and grabs its prey from a distance over which the unsuspecting fly or bug hardly deems it possible that the enemy can reach. The lizard's mode of seizing the insect is not only peculiar but also gives further proof of the dull nature of its perception. It never uses but one eye, and, while its body is perfectly motionless, will follow the movements of its prey with intense attention until it comes within about three inches of its nose; and then a tongue will dart out, more like a streak of pink lightning than anything else, strike the insect, and carry it back into the mouth. This tongue, which is out of all proportion to the size of the animal (sometimes twice its en-

which has a cup-like cavity on its anterior surface, always covered with a viscid fluid. It shoots out a perfectly straight rod, and strikes the insect with unerring accuracy.

M. Bert, who has dissected the operating mechanism, says that the tongue is squeezed out, just as a cherry stone can be forced out by pressing the fruit between the fingers. Strong bands of muscles, surrounding the tongue, serve to apply the necessary pressure.

THE BEHAVIOR OF METALS UNDER STRAIN.

BY PROFESSOR E. H. JOHNSON.

The resistance of metal to rupture is dependent upon two conditions: the first is the magnitude of cohesive force; the second is the homogeneity of the material.

A metal is homogeneous in composition when all portions exhibit the same chemical constitution; it is homogeneous in structure when all parts exhibit the same arrangement of particles; it is homogeneous as to strain when all portions exhibit the same degree of what is called "internal strain."

This internal strain is produced whenever particles are given positions which are not those of equilibrium, and, consequently, such that they exert greater or less force to change their relations with surrounding molecules. The character, and the occasionally serious amount, of this kind of strain is exhibited by the weakness of large masses of metal, whether cast or forged, which is so frequently observed. Every one who has seen much of large work has known instances in which castings have cracked while cooling in the mold, and every pattern maker and every molder understands the necessity of making allowances for "shrink," and the advisability of avoiding the combination of thick with thin parts in the same piece of casting.

In large and dense castings, the difficulty is less than with cast iron, and in iron forgings the difficulty is still less. This condition does, however, sometimes exist to a serious degree, even in wrought iron when worked in large masses; and the steel rods, several inches in diameter, which it was attempted to make some time ago for one of our great bridges, were found in some cases to possess but a fraction of the strength, per square inch of section, which the same metal exhibited when cut into small pieces.

It follows, therefore, that, to secure the most reliable metal for purposes of construction, uniformity in composition and structure and freedom from liability to internal strain must be secured, if possible, as well as high cohesive strength.

It is, however, usually impossible to avoid the presence of internal strain, since artificially produced materials, like the metals, cannot be given form except by external force. It becomes important, therefore, to study the character, the effects, and the means of relieving or avoiding internal strain in order that we may know where to look for it, and how to prevent difficulties consequent upon its existence.

The existence of internal strain in castings has been long well known, and the large masses of cast iron frequently produced in every foundry are always either very slowly cooled in order that uniform contraction and solidification throughout shall prevent dangerous strains occurring, or they are carefully annealed, or they are artificially cooled—as in making the Rodman gun, for example—in such a manner that the strain which may occur shall be of actual service by adding to resistance of external forces.

The extent to which wrought iron may be weakened by internal strain, and the behavior of the various qualities as affected by its presence have only recently attracted much attention from engineers.

A somewhat extended experimental research, made by the writer, has resulted in the discovery of some interesting facts and leads to some useful deductions. The limits of a short article like this forbid such an extended account of these investigations, as is given at length in more purely technical journals; and a more rounded view of the work and of the conclusions derived from it must suffice.

It was found that all metals exhibited the presence of more or less of this cause of weakness, the harder varieties being more seriously affected, and the ductile and soft kinds showing it least. The same grade of metal was found to contain an amount of internal strain, which varied according to the treatment to which it had been subjected during, or subsequent to, its manufacture.

The harder kinds of iron were capable of taking up additional strain when subjected to the process which produces hardening in steel, and all grades were found to lose it by the operation of annealing. The harder metals were found to be more liable to injury, by reduction of their ultimate strength in consequence of the presence of internal strain, than were soft varieties.

It was found that internal strains could be modified by external forces, and that this fact has a most important influence upon the behavior of the metals, and consequently, upon their availability for purposes of construction.

It has already been stated in the SCIENTIFIC AMERICAN that the discovery was some time ago made that a piece of iron or steel, left for some time under a load, acquired an increased power of resisting further change of form. It has become very evident, as further experiments have been made in studying this remarkable action, that this is the effect of the gradual relief of pre-existing internal strain. It is unobservable in bodies free from such strain, and is noticed in cases where internal strain exists, sometimes producing a very large reduction of resistance.

This relief occurs by the "flow" of particles, as it has been called, a well known property of solid bodies subjected

to great force, and which is best illustrated by the process of "squeezing" lead pipe, and less strikingly whenever metals are worked in the rolls or under the hammer.

A piece of metal being placed under the action of external force, some of its lines of particles are more strained than others, and the mass does not resist change of form or ultimate fracture with its maximum power. Its forces are overcome in detachments. Left under a load not capable of breaking it, however, the particles are gradually shifted by the applied force and "flow" into new positions with a rapidity which is greater as the material is more ductile. The available forces of cohesion are now combined, and, pulling together, can offer more resistance than at first.

After this fact had been discovered and its probable cause had been ascertained, it was considered very likely that the converse might be true, and that rapid change of form and sudden rupture might be less resisted than a slow action. Experiment promptly proved the correctness of the conjecture, and it was found that a very serious loss of resistance frequently took place under such sudden strains as those produced by blows. The second discovery, which had been made by Kirkaldy* at an earlier date, although apparently not accepted by the profession on account of the possible action of inertia in his experiments, is even more important than the first, since it shows that structures and machinery exposed to shock are not as safe as they have been supposed, although the first described effect of internal strain would appear to produce an increase of resistance to static forces.

Dead loads can therefore be sustained with greater safety than had been previously supposed, while with live loads the contrary is the fact.

It would seem that rapid change of form introduces internal strain more rapidly than it can be relieved, and thus weakens the metal, while very slow alteration permits a certain amount of "flow" and relief of strain, and gives a higher strength in consequence.

The effect of relief of internal strain was discovered nearly forty years ago by Professor Johnson, while conducting the Franklin Institute experiments on the causes of boiler explosions. He does not, however, seem to have suspected the cause, and speaks of the phenomenon as "anomalous." He relieved internal strain by what he called "thermo-tension," heating the metal to a high temperature, applying a heavy load, and allowing it to cool under tension. He states the amount at about 15 per cent for Bessemer iron, and 20 per cent for some specimens of Tredgill. It would appear that we find here the secret of the exceptional behavior of wrought iron, in exhibiting a gain of strength at high temperatures.

From this fact, and from the experiments of the writer, the inference has been drawn that, the more ductile the material, the more readily and completely may internal strain be relieved, and the safer is the material against shock.

I conclude also, that parts should always, if possible, be so proportioned that all parts shall stretch uniformly if liable to accidental injury, in order that the reduction of strength, due to rapid distortion, may not weaken it as several times of strain successively, and produce rupture by thus taking the parts at a disadvantage.

Where parts are liable to injury by shock, they should also be slightly thickened up near the part exposed to the blow.

In selecting material for constructions peculiarly exposed to injury by shock, we see that it is particularly necessary to obtain pure and ductile iron.

For structures like steam boilers, which are continually changing form with variations of temperature and pressure, it is even more necessary to select the best of iron.

STEVENS INSTITUTE OF TECHNOLOGY, March, 1874.

SCIENTIFIC AND PRACTICAL INFORMATION. RAISING VESSELS.

In raising sunken vessels, it has been common to use flexible straight bags, which, when properly secured to the vessel, are inflated with air by pumps. A recent improvement, by Mr. Sewerhaite, of England, consists in supplying acid and alkali to the bags, which, as being mixed, generate carbonic acid within the bags and produce the necessary inflation, so air pumping being unnecessary.

NEW APPARATUS FOR REGulating THE DIRECTION OF CLUSTERS.

M. de Parville proposes for this purpose a board some 12 inches long by 8 inches broad, fixed on a suitable support. A square of unpolished glass placed vertically, divides the plane in two equal parts. The left hand side of the latter is covered with a mirror; on the right is a sheet of paper. As the clouds pass above the horizontal glass, they are reflected; and at the same time the observer sees their images on the vertical glass projected on the paper. It is only necessary to trace their direction on the latter with a pencil. On the mirror is engraved a compass card, which is also reproduced on the paper, and a small magnetic needle is suitably arranged so as to adjust the apparatus.

THE WASTE OF COTTON SEED.

Mr. Alkin, of South Carolina, says that the loss by neglecting to save cotton seed is immense; piles of seed are allowed to decompose and waste at nearly every gin house, and yet the seed is a valuable measure. For cultivated crops, 30 bushels of cotton seed in the drill, or 50 bushels broadcast, to the acre will increase the crop considerably. Seed can be sown by composting it in alternate layers of leaves, straw, and stable manure; 100 bushels of green cotton seed, mixed in bulk with a ton of soluble phosphate and allowed to remain a fortnight, will make a capital compost for 10 acres of any cultivated crop.

*See several volumes of Trans. Am. Soc. C. E. and Journal Franklin Institute.

THE LIGHTNING SCREW PLATE.

The chief feature of the invention represented in the annexed engravings, to which the reader's attention may be first directed, is that the die does its work in a single cut, thus forming the screw thread at once, instead of by several trials, as is the case with the implement in ordinary use. In order to compensate for wear, the die is capable of proper adjustment, so that it is claimed to keep its size with accuracy until used up, or over a long period of constant employment.

The complete tool is represented in Fig. 1. A is the die, which is secured in a suitable collet, B, which, in turn, is held by the set screw, C, in the plate. A $\frac{3}{4}$ inch die, that being the largest size, is represented as secured in the latter, and below are shown the remaining six sizes of dies with their corresponding taps, namely, $\frac{1}{2}$, $\frac{3}{8}$, $\frac{1}{4}$, $\frac{3}{16}$, $\frac{1}{8}$, and $\frac{1}{16}$ inch, all of which are supplied with the tool.

In the sectional view, Fig. 2, the construction of the die and its mode of adjustment are depicted. D are tapered-headed screws, which spread the die when driven in, while the screws, E, serve to close the parts of the latter together from the sides. The taper screws govern the size of the cut; and after they are regulated, the binding screws hold the portions firmly in place.

It is claimed that this invention will accomplish five times the work possible with any other screw plate. The dies are cut nearly and sharply into the bolts, and not, as is frequently the case with the common tool, jammed out of the iron so as to raise the threaded portion above the normal surface, thus impairing the accuracy and regularity of the operation. The die allows of cuts and bolts for different purposes being made to fit together tightly or loosely, as desired. When worn out they can be replaced, the plate and collets remaining good. The articles threaded need not be machined and kept together, as they always correspond without being tried or fitted. The collets holding the dies have guides, as shown at F, Fig. 2, for starting bolts true, though, when it is desirable to cut close under the heads of the latter, the face side is used. The design of the plate combines simple strength with remarkable lightness; and in quality, style, and finish, the device appears to be an excellent tool.

For further particulars address Messrs. Wiley & Russell, Greenfield, Mass.

THE GRASS EATING FISH.

Nature makes no leaps; on the contrary, she appears to fill up, by design, the gaps which appear to exist between each parallel series of beings. Numerous examples exist, or have existed, of these odd connecting links; the Australian emu-bird, a quadruped with a bird's beak; the apteryx, a bird with hair and no wings; the pterodactyl, or winged lizard of antiquity; the fossil turtles, with teeth, found in the Cape diamond diggings—are illustrations in point, and still another is found in the queer fish represented in our engraving. It is called the *caracaras Forsteri*, and is allied to the fishes through the *lipodactylus*, a singular animal found in the streams and ditches near Bahia, Brazil. The *lipodactylus* is popularly termed the eel-caracaras, and is known by its odd shaped, elongated body, covered with scales, appearing to terminate in a fish's tail, while its means of locomotion consist in four fins located underneath. French naturalists have placed this animal in a distinct class of amphibious reptiles. Owen, on the other hand, pronounced it a fish, and the connecting link between fishes and reptiles.

The discovery of the *caracaras*, however, adds to an even closer connection between the two families. The genus was established by Agassiz, who found the fossil teeth and jaw bones of the animal in the Jurassic and triassic formations of many parts of Europe. It was supposed that, since in these epochs reptiles, the *caracaras* did not exist, yet in few years since, when living specimens were found in the rivers of northern Australia, exactly corresponding to the fragmentary relics.

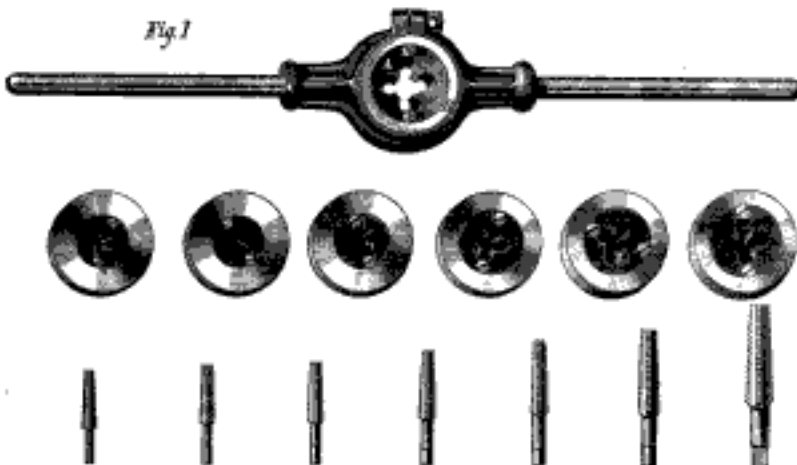
In the annexed engraving is represented the appearance of the living fish and also of the skeleton. Its length is about 36 inches, and its diameter 2 inches. Its habits are as peculiar as its form. Although living in the stream, it rarely ascends above the leafy bed, and feeds the most common of the vegetation which, growing in shallow places, is left uncovered by the ebb of the tide. At night the fish leaves the water, crawling in among the plants and feeding. The quantity of nourishment it needs is enormous, and it is said that the amount of half-digested myrica and grasses which it consumes is the size of a large bush. It is a voracious animal, and its habits are very peculiar. It is a voracious animal, and its habits are very peculiar.

apparent requirements of the animal. In order to pursue its habits, it is evident that air-breathing apparatus must be present in the organization, and such is the case. Its gills are a sort of porous lung, of very complicated construction, having ramifications which expand into cavities filled with a coagulum, the function of which has not been definitely determined.

Inventors' Mistakes.

Inventors are too liable to think that upon the granting of their patents success is certain, which it would be if they would display as much business tact as they have done inventive ability. Upon the granting of a patent the inventor thinks his "fortune made" and thereupon sits down,

Fig. 1



THE LIGHTNING SCREW PLATE.

waiting for the dollars to come without any effort on his part to induce a flow of coin into his treasury. After a season of such inactivity, with poverty finally staring him in the face, he parts with his patent for a small sum to a shrewd business man, who places the matter before the public in a business-like way, advertising it in moderate terms, which it reaches the attention of all in need of that particular invention.

Fig. 2



eventually creating for it a large demand, and bringing a correspondingly large revenue to the advertiser.

The day has passed when people having any desirable thing to sell may expect to reap success by waiting for the public to seek them out. At the present day, every important branch of manufacture has its own special organ; if an inventor has

Hints on House Papering.

This is the season, among good housewives, for cleaning, whitewashing, painting, papering, and otherwise renovating the domicile.

After the cleaning, whitewashing, and painting is accomplished, comes the process of papering the walls; but the first thing, frequently, to be done is the removal of the old paper. To do this successfully, wet the wall thoroughly, and, when well soaked, the old paper can be stripped off very quickly. After the paper is removed, wash the wall to get off all the particles of paper which may remain, and leave the walls till nearly dry before commencing to lay the new paper. If the walls have been whitewashed instead of papered, wash the walls with vinegar, which will make the

paste and paper adhere more securely. A bench is usually made for measuring and cutting the paper, by placing boards of suitable length across two four barrels. The paper should be unrolled and cut to proper length and in sufficient quantity to cover the room, before the pasting process commences. These sheets should be laid one over the other, so as readily at hand when the paper is ready to begin work. The liability of tearing the edges or damaging the paper will be greatly obviated by adopting this custom. Floor paste is the usual article for the purpose, and rye flour is considered better than wheat, as it has more adhesion. Mix the flour in cold water thoroughly, by stirring, until the paste has the creamy consistency, and then boil, when it will thicken, according to the length of time it is subjected to the heat. If found too thick in cooling, add boiling water till the desired degree of thick-

ness is obtained; then add a little carbolic acid to prevent the paste from souring or becoming moldy. A brush with wash brush is the best to apply the paste with, and the paper should be laid quickly after pasting, to prevent its becoming soft and easier to handle.

Two persons are required to lay on paper with rapidity, one to paste and one to apply the paper. When the paper is pasted it should be handed to the person on the ladder, who holds it about a foot from the top end, and lays it evenly against the wall at the top, allowing the upper end to hang over on the backs of the hands. By looking down the wall, it may be seen when it reaches the previously laid length; and after adjusting to match, it should then be brought gently to the wall, the backs of the hands then pressed against the wall and passed upwards towards the ceiling, spreading them out towards the corners of the length of paper. The corners are then run along at the juncture of the wall and ceiling, making a mark which can be easily seen, when the top of the paper is removed for a little distance, and it is cut off even and replaced. Then a soft cloth is gently passed downwards and the paper pressed against the wall to the bottom, where it is cut off as at the top.

Iron Electrotypes.

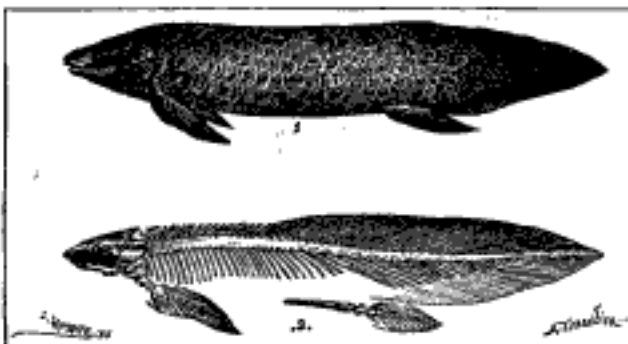
A brief item on this subject appeared in a former issue of the *Journal*, to which we may now add the additional declaration that M. Klein, a Russian chemist, has succeeded in obtaining very satisfactory results from a series of experiments in this direction.

The process followed by him is described as follows: The bath employed consists of a concentrated solution of sulphate of iron and ammonia, and the battery of four Neidinger cells. For an anode, an iron plate is used, with a surface about eight times that of the cathode; and connecting this with a copper plate, a perfect coating of iron is obtained. On leaving the bath, the iron, it is said, is as hard as tempered steel, and very brittle. When heated, however, to a cherry red, it is said to become malleable, and may then be engraved as easily as soft steel.—*Journal of the Franklin Institute.*

[Our readers will find a full account of M. Klein's process, above alluded to, for the production of iron electrotypes, in the *Scientific American* of November 16, 1873.]

The invention was patented in this country by M. Klein, of St. Petersburg, Russia, September 29, 1873. The Hon. Olenius M. Clegg, then United States Minister to Russia, brought home some examples of the new process, consisting of iron electrotype plates for printing, being copies of engraved copper plates. These examples were very perfect. They were for some time on exhibition in this office and were noticed in this paper November 22, 1873, a full account of the process being then also given.—*Sci. A.*

THE GRASS EATING FISH.



anything to sell which is worth saying, the attention of publishers is expected to be called to the fact through such publications, as well as through the mailing of circulars, etc. A large proportion of the patents granted are for inventions of real value, and of value to the public, and inventors and the public are alike benefited by this way of business tact on the part of inventors, who should, immediately upon the issuing of the patent, have it properly engraved and published in such journals as reach readers who require the use of such particular inventions. "Markedly inactivity" has ruined many an inventor who might otherwise have been to-day in the possession of a fortune.—*New York Herald.*

No pillar of support of brick or stone should ever exceed in height the width of its base, and no building should be constructed on a soft or yielding foundation.

The *Chomans* and *Cherokians* of Indian Territory sold 8,000 bales of cotton last season, paying twice as much as the crop of 1872. Most of it went to the St. Louis

SELF-ACTING FLOOD PIPES FOR BUILDINGS.

We herewith publish engravings of a device, designed by Mr. Stewart Harrison, of London, England, for the purpose of automatically flooding with water the interior of a building attacked by fire. It is exceedingly simple, and its operation may be understood at a glance.

The self-acting pressure valve (Figs. 1 and 2) is so constructed that the valve is held in its seating, so as to prevent the efflux of water, only by a conical brass plug, carrying the stem or spindle of the valve, and retained in position within a suitable conical recess seat by an annular wedge of fusible metal. Between the valve and the plug there is a perforated hollow spheroid, which acts like a rose, to distribute the water when heating under pressure on all sides; and this rose and the plug beneath it necessarily project downwards below the ceiling, for obvious reasons, the supply pipes being affixed by holdfasts to the joists above. Then, in case of a fire occurring by accident, generating flames and elevating the temperature, so soon as the boiling point of water is attained the fusible plug melts, the plug drops out, the valve falls, and water in continuous streams is at once discharged upon the fire and flame, extinguishing them before they can spread or gather strength so as to become uncontrollable; in fact, the fire is the immediate agent and exciting cause of its own destruction.

So far it is clear there is nothing out of the way or impracticable in the scheme; nothing involving any departure from existing practice, as in the case of gas and water pipes, bell wires, speaking tubes, and the like; of which, indeed, it is the ordinary and extensive. But it obviously involves the absolute existence of a constant public water supply, at high pressure, accessible and available; or, in default thereof, of adequate storage of water in cisterns, of sufficient dimensions, suitably placed, to give the requisite supply and pressure. It is obvious also that some expedient in relation to the circumstances of a fire, by which ingredients and due circulation, would be advantageous or necessary.

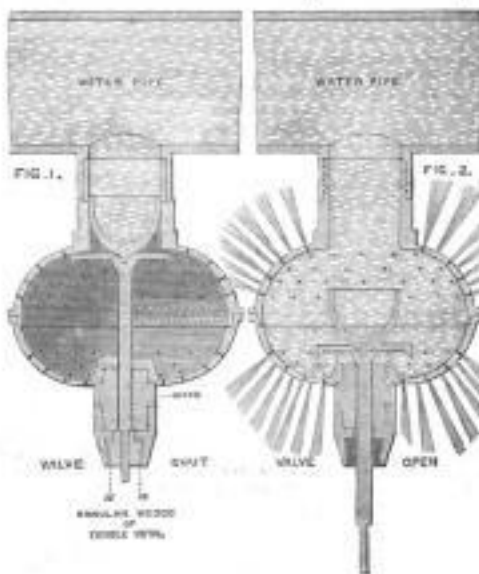
Individuals of an acquiring turn of mind may speculate upon the case of a fire breaking out at night, and being thus extinguished, of necessity without being discovered; when, of course, the water would continue to flow, to the serious injury of furniture, goods, merchandise, etc. Without entering on the discussion as to which of the two evils, excess of fire or water, be the least, it will suffice to remark that Mr. Stewart Harrison has at least not neglected this aspect of the case. He provides for the difficulty (says *Lewy*, to which we are indebted for the engravings) by a very simple contrivance, the adoption of an arrangement to give warning of the occurrence of a noxious fire, by the flow of water being made to depress a piston, raising and setting in motion a suitable alarm on the premises; which, by the very simple aid of making a connection with a galvanic battery, and completing a circuit, might, if required, be made to ring an alarm bell situated anywhere, where, these alarms continuing until attention is aroused, and enforcing the active agency of a human being to turn off the water and stop the flow and the alarm simultaneously.

LEWY'S ZERO REFRIGERATOR.

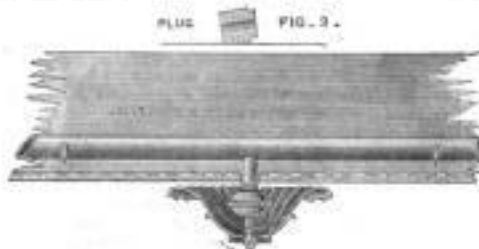
We remember reading, some time ago, a queer story—very much on a par with the various recitals of Baron Munchausen—about a party of hunters in the arctic regions, who, while pursuing the chase, suddenly discovered two strange objects protruding through the frozen soil. Closer examination proved the articles to be nothing more or less than a pair of boots, and a still more striking curiosity indicated the fact that said boots contained legs. Setting to work with axe and pick, the hunters proceeded to dig out the bodies of the body, and finally on took a remarkable individual, dressed in the garb of centuries back, and, of course, frozen stiff. The story goes on to tell how, while they were debating as to the disposition to be made of the odd discovery, they left the body by the camp fire, where it thawed, and its owner, to their astonishment, signalled his return to existence by a howl for brandy. Then the romance recounts the yarn, which the resuscitated ancestor tells his descendants, of life a few hundred years back, and how he became frozen in the ice and had slept a Rip Van Winkle sleep, preserved by the intense cold. The sequel is that the old gentleman tells entirely too many stories, and because a bore, whereupon the afflicted hunters suggest that he is sufficiently indebted to cold to sleep out of doors. He does so, and again freezes stiff, in which condition the party very gladly leave him to his fate. While the return to life of an individual who had been frozen several centuries is rather without the bounds of probability, the fact of his keeping that length of time is not. In the frozen earth of Northern Siberia, the bodies of man and beast, still covered with flesh and skin, have been found in a state of such preservation as to furnish food to living animals—a circumstance which doubtless, in some way, may give rise to the foregoing story; and, in general, it is a well known fact that, in organic substances, when kept at a cold temperature, decomposition is arrested. If, in addition to cold, the atmosphere be both dry and uniform in temperature, decay may be prevented by artificial means for an indefinite length of time.

The necessity of securing, as complete as possible a freedom from humidity in the air, of mosquitoes in which insects and vegetables are to be preserved, is a point of importance which deserves to be widely understood. In some climates,

as in North American countries, parts of Texas and California, and in special localities where a naturally dry atmosphere prevails, articles of food are kept without the aid of the refrigerator and with little trouble. Generally, however, in the climate of the United States, moisture is present, a circumstance plainly exhibiting itself by the condensation on the cold surface of pickers containing ice water in summer, or on the exterior of the window panes of warm rooms



in winter. Hence, it must be one of the principal objects of a refrigerator, which initiates the action of Nature, to keep its contained air in as dry a state as possible. This manifestly cannot be done if meat, vegetables, milk, butter, and other substances are all packed in a single compartment with the ice.



Professor Loomis points out that if moisture is present, as temperature greater than the freezing point can wholly prevent decomposition. Meat, therefore, once placed upon ice, prepares itself to decay at that temperature, and if removed spoils quickly. Hence it is that, when removed from the butcher's chest, in hot weather, it frequently becomes unfit for use in a few hours. It needs no argument to prove the dampness present in single compartment refrigerators, and from their close密封 smell, the mingling of odors within them, the neglect of servants to keep the blankets used to cover the ice perfectly clean, and from similar defects, their sanitary value is at best questionable. In refrigerators



where the ice is in one division, and the articles in another, a point of advantage is aimed at; but, clearly, if the moisture in the food compartment be allowed to condense on the cold surface of the ice box and then to flow back on the meat, etc., the object sought is not secured.

A full knowledge of the considerations above advanced has, however, been brought to bear in the construction of an improved refrigerator, manufactured by Mr. A. M. Lewy, of

204 and 206 West 23d street, in this city, the newest form of which is represented in the annexed engraving. The zero refrigerator, as heretofore made by Mr. Lewy, differs from that illustrated herewith in having less ice space, the ice compartment being in the center of the box, and having curved sides meeting just below the faucet in front. This partly gave more room for articles in the lower divisions; in many cases, it is desirable to secure a supply of ice which will last a considerable time, the section for the same has been enlarged. In this division the blocks are placed, upon a wooden tray, through which the water runs to a charcoal filter, which covers a small central compartment, shows through the right hand open door. This gives a supply of pure ice water, which may be drawn off as needed by the faucet. The moisture condenses upon the surface of the ice box adjoining the food receptacles, and thus leaves the air in the latter in an almost dry state. It then runs to a trough, and thence is conducted, to a pan located under the apparatus, by a suitable pipe, in which a trap or siphon is placed so as to prevent an escape of cold or an influx of warm air. On top, and beside the ice box, is arranged a receiver for wine bottles, milk, etc. Each compartment has its own door, so that access may be had to any one without disturbing the others, and hence no warm air gets to the ice except while the supply is being replenished. The inventor states that moisture is never seen on the inside lining, and that the provision chambers are always sweet and clean. Matches, we are informed, which absorb dampness readily, have been placed in the refrigerator, as a test, without injuring them in any way. The consumption of ice is said to be remarkably small.

The zero refrigerator is constructed of clean, well seasoned lumber, filled with cork, lined with zinc, and is provided with a galvanized iron ice box. Mr. Lewy subscribes a very large number of commendatory testimonials, together with premiums from three American Institute fairs, and from many exhibitions throughout the country. Further particulars may be obtained by addressing the inventor at above.

The Artificial Production of Low Temperatures.

BY PROFESSOR RICHARD L. LOMIS.

By the Windhausen process, a steam engine is employed to condense air to, say, two or three atmospheres. The heat developed by the compression is drawn off during the passage of the condensed air through pipes in a series of chambers, in which cold water is flowing. The cooled air is then allowed to expand into a cylinder under a gradually diminishing pressure, the expansion being attended with the development of great cold. It is claimed that under a pressure of but 15 pounds to the square inch a reduction of -54° Fah. has been obtained, a surprisingly low temperature, considering the means employed.

The following modifications of the apparatus would render its cold-producing power almost unlimited:

1. A communication between the expansion cylinder and the chambers through which the condensed air is conducted before it is allowed to expand. Supposing this outlet regulated by a cock, a blast of very cold air could replace the running water, and reduce the condensed air to a very low temperature.

2. The introduction of a second compressing cylinder, with which the condensed air, after being cooled, could be still further compressed, again cooled, and finally conducted into the expansion cylinder. Under a pressure of, say, 60 atmospheres, a considerable mass of air at the temperature of say -100° Fah. would, in its expansion, produce a reduction of temperature greater perhaps than any yet obtained. Since by means of the communication between the expansion cooling chambers, the condensed air can be lowered to any temperature obtainable in the expansion cylinder, there would appear to be no other limit to the reduction of temperatures save what would arise from the strength of materials, or the liquefaction and subsequent freezing of the nitrogen, or the oxygen of the air, or of the air itself. Among the advantages that we may rationally expect to accrue from the apparatus thus modified are the following:

1. The confirmation or otherwise of the "absolute zero," as determined by the expansion or contraction of gases by heat or cold.

2. The liquefaction and subsequent solidification of many of the incompressible gases, the determination of their physical peculiarities as liquids or solids, together with their crystalline form.

3. The action of intense cold on the chemical affinities of certain gaseous compounds.

4. The action of intense cold on the color of certain chemical compounds.—*Journal of the Franklin Institute.*

[In the *Scientific American*, September 28, 1870, is given a description of a refrigerating apparatus, by Dr. Garcia, which presents an arrangement apparently analogous in idea to that suggested above by Professor Loomis.—*Eds.*]

THE FROG BAROMETER.—In some countries frogs are used as barometers: the species employed for this purpose is the green tree frog. They are placed in tall glass bottles with the wooden ladders, in the top of which they always climb in fine weather, and descend at the approach of bad weather. This is a cheap and highly interesting weather glass where the green tree frog is to be procured in its natural state.—*Scientific Gossip.*

Correspondence.

The Ventilation Question.

To the Editor of the Scientific American:

I am glad my remarks on the present mode of ventilating the senate chamber, Washington, have called some attention amongst your scientific correspondents.

Some time ago I was requested to examine the lecture hall of the Paisley Free Library, with a view to its ventilation. This choky place had become proverbial for its insalubrious state with even a thin audience. The hall is well proportioned, and will seat 400 or 500 people. On examination I found the "sarking," whereon the slates are fastened, to be grooved and feathered, and as tight as a cork. The plastered ceiling is pierced with open framework. Several air grates are in the masonry below the level of the floor, but the floor itself is as tight as the sarking. When the hall was filled, no draught could be detected at the air gratings. In the center line of the floor and along the whole length is a strip of iron grating over the hot water pipes. These pipes lie in a bored channel, slightly except at top. From this arrangement, it will be seen that no fresh air could enter the hall unless by an occasional opening of a door or window. To effect a cure, the first thing was to get a hole made through the roof. Luckily there is a hatch in the roof for repairs. Here was the very thing wanted. This hatch was fitted a few inches and kept partially open by two small blocks of wood. This secured the "outlet," and so far no more was required. Under the floor a few of the "dwags" were then knuckled out from between the joists. These dwags formed the sides of the channel where lie the hot water pipes. A communication was thus made between the outer wall gratings and the hot pipe channel, and consequently to the hall itself. Having thus made an opening between the hall and the outer fresh air, and having secured an escape for the warm foul air by the hatch in the roof, the arrangement was complete. Next lecture night, the audience no sooner began to assemble than the inevitable result manifested itself. The inward current at the wall gratings was not to be mistaken. A paper torch flame was sucked in. It worked lively to begin with, and got more so as the hall filled. At the same time, the hatch outlet did its work to a wish. The result of this simple and inexpensive plan is that everybody is satisfied. To arrange this did not take much longer time than it has taken to describe it. One hall ventilated in this way and found to answer is as good as a thousand for conviction, and Nature knows no difference between the senate chamber and our lecture hall. It only requires the same arrangement to obtain the same result. A trial by objectors would save them the trouble of creating bughouses against its adoption, for the arguments against my plan by your correspondents are simply nothing. "Prove all things" is as good in this as in higher matters, and would be more philosophical than railing against an untried plan.

It would not be difficult to answer every objection raised by Messrs. Morgan and West; and if I were unable to do this, the fact remains that the plan has been tried and has not been found wanting. It has worked, is working, and will work so long as the laws of Nature remain as they are.

Mr. West supposes I allude to summer ventilation only; but I include all seasons. So long as a crowded hall is warmer than the outer air, the upward current is bound to flow. The dread of cold can only come from the unseasonably large supply of air forced into public halls by such philosophers as suppose that it is required that each person should have twenty-five cubic feet per minute, that is, fifty times more than he can consume. The rapid lowering of the cozy warmth of a hall by the admission of a large quantity of cold air in winter is not to be feared in my plan. To keep a crowded place sweet, not much fresh air is required; and if it be admitted under the hot water pipes, it will keep the place snug and comfortable.

Mr. Morgan, "purposely ignoring the special subject of my article, the senate chamber," shows a wise discretion. His says, misquoting me: "If our halls, like the ancient Greek houses," etc. I never spoke of Greek houses. I only mentioned halls, which were very different. My remarks referred to a crowded place—the senate chamber—with probably 1,200 people in it. Mr. Morgan's tall glass jar is no proper illustration of the senate chamber, which, looked at as a vessel, is not tall but fat. Its narrowest diameter is more than twice its depth, so that an old-fashioned punch bowl or a wash hand basin would better represent it than a tall jar. He says: "If a bit of lighted candle be placed at bottom of a tall glass jar and subjected to a stream of carbonic acid from the lungs, the light will be extinguished." Likely enough. But this is no illustration of the action of natural ventilation in a roofless hall. I did not say that if a flood of carbonic acid were poured into such a place, the people in it would live. What I said was that pure air would descend and replace that vitiated. Nature does not supply carbonic acid in the manner of Mr. Morgan's experiment.

But I also offer the same experiment, whence the impossible carbonic acid, as a proof that my position is correct. Place a bit of lighted candle at bottom of a tall glass jar open at top, and it will not be extinguished so long as any of it remains to burn. This is the position of an audience in a roofless hall. The vitiated air produced by the lighted candle, being lighter than the atmosphere, rises and escapes at the jar's mouth, while pure air at the same time takes its place through the same opening. This jar experiment reversed shows that carbonic acid whilst warm rises. Hold the same jar mouth downwards, and thrust a lighted candle half way

up. The foul air will collect at top; and when it has filled the jar down as far as the flame, the candle will be extinguished. Light the candle again, and hold it only a little way up; and when the carbonic acid has filled the jar, the candle will go out. According to Mr. Morgan's false theory, the carbonic acid should have fallen out of the jar and left the candle to burn.

Another experiment with the tall jar, and I will lay it aside. Cut a hole, say half an inch, in the bottom of the jar, and hold it mouth downwards. Thrust a lighted candle up as before and it will not be extinguished. And why? Because the carbonic acid rises and escapes by the hole, and a current of pure air enters by the down-turned mouth and feeds the flame. The same events take place in a crowded hall having a hole in the roof and inlet below. The inverted jar represents the hall; the candle, the heat-producing audience; the down-turned mouth, the inlet for fresh air; and the hole in the jar, the outlet in the roof.

I am obliged to Mr. Morgan for suggesting these experiments, but I daresay he did not expect they would be turned against his crude scientific notions. His statement that, if my plan were adopted, the people would be "freed out" by warm air needs no comment, and his platitudes about the "destroying angel" need as little, as nobody denies them. About my running counter to Reid and others, if it be so, all the worse for them. Reid knew well enough the principles I have laid down, but he failed to put them in practice. He would help Nature with machines, engines, exhausts, and other expensive contrivances, and failed to ventilate the parliament houses, after spending thousands of pounds; whereas a carpenter with his saw could have done it for a few shillings, and so could he the senate chamber, Washington.

WILLIAM MACKIN.

Paisley, Scotland.

Turbine Limitations.

To the Editor of the Scientific American:

Perhaps most water-wheel engineers have a theory of the action of the water upon the turbine, and construct their wheels accordingly; but it seems to me that there is a very important item (which may be called "turbine limitations") generally overlooked. It is simple enough, and as follows: The guides of all turbines divide the water into jets impinging upon the buckets in a forward direction. It is generally conceded that these jets in passing through the wheel must be deflected from their forward to a perpendicular direction (not more nor less) and that the wheel buckets must be as thin as possible, and shaped so as to enter and pass through them exactly edwise, or with as little disturbance as possible. Hence it becomes an important question: At what point or how far from the guide issues, will these jets have changed their forward into a perpendicular direction? For here, and here only, is the point for the wheel's losses, since nowhere else could they discharge the water in the right direction, or just so fast as the wheel moves.

It need not be remembered that the pressure necessary for propulsion must of necessity cause a given deflection in a certain distance or lapse of time; hence it must seem that, in all turbines, there is a limited distance (smaller at which guide and wheel issues can be placed, fixed by this time or distance of deflection. This law would require a certain size and length of bucket, together with distance apart of guides, irrespective of the size of the wheel, a practice very different from that at present in vogue. Good wheels are made that do not comply with this idea; yet I am convinced that, as turbines have evidently improved as more guides and thinner and smaller buckets are used, it is because of a nearer approach to compliance with this law.

Springfield, Mo.

J. R. REYMAN.

The Attraction of the Sun and the Earth.

To the Editor of the Scientific American:

That the relative attractions of the earth and the sun on the same terrestrial body are subjects of calculation, the odds furnishing the data, is well known. The only question in my mind was: Are the data so exact as to render anything further desirable? In making the experiments suggested by me, the object sought would be an accurate measurement of these forces, respectively, by means of the same instrument. Of course common level scales would not answer; and it is a question whether springs could be constructed of sufficient strength and delicacy combined.

Two expedients have occurred to me: First, the use of a delicate spring balance having a mirror attached, by means of which effects, invisible to the eye as an ordinary register, may be made sensible and measurable by the reflection of a beam of light to different points of a graduated arc. Secondly, I can see no reason why the minutest difference in these attractions may not be accurately measured by means of the pendulum. This instrument serves as to determining the sphericity of the earth, the earth's density, and the height of mountains, and it certainly would serve for the purpose of measuring the solar attraction also.

Brewersville, Neb.

W. R. BLAUGHTON.

Railroad Curves.

To the Editor of the Scientific American:

The radii of curves, with their corresponding deflection angles, can be more readily found from the relations between the arc and diameter than from those between the chord and diameter, the latter being the method in use at present by railroad surveyors.

If we assume the linear value of 1° of arc to be 1 foot, as the measuring unit, then the radius is known to be 57-29578 feet. If, instead of calling the arc of 1° equal to 1 foot, we call it 500 feet, then the above radius is also 500 times greater,

Hence we have the radius of a 1° curve, by simply removing the decimal point of the above figures two places to the right, that is, the radius of a 1° curve is 5729-578 feet. It is also known that, if a given amount of arc be developed linearly, on circles of different radii, the angles subtended will vary inversely as the radii. Hence, to find the radius of any other deflection angle, we have only to divide the radius of a 1° curve by the number of degrees in the given angle. The radius of a 4° curve is thus one-fourth that of a 1° curve; and for a 7° curve, one-seventh and so on.

Again: If the deflection angle is less than 1°, we have only to multiply by the fraction of the degree inverted, thus: Multiply the radius of a 1° curve by 60 for that of 1' curve; for a 4' curve, multiply by 15; for a 10' curve, multiply by 6, and so on. By reversing this process, the deflection angles corresponding to different radii may be found.

Furthermore, we may compute any of the trigonometric functions for the radius of a 1° curve, and then pass, by the method of inverse ratios, to the corresponding function of any other deflection angle. Thus the tangent of 38° of arc on a 1° radius would be 4476-60 feet. On the radius of a 4° curve, it would be but one-fourth as much, namely 1119-15 feet. To find this element by methods in present use, we should be obliged to resort to trigonometry, or be satisfied with some approximate method. In the same manner, other functions may be determined.

Among the many advantages resulting from assuming a portion of arc rather than of chord, for the constant quantity, are the following, namely: 1. The saving of immense labor in the comparison of radii for different deflection angles; 2. the method of inverse ratios, much in use by surveyors because of its simplicity and ease of application, but which gives only approximate results, will then become rigorously correct; 3. the total deflection of a curve is known from its length in feet. If for a 1° curve, we have only to cut off two figures to the right, and we have the total deflection in degrees and decimals. If for any other curve, we have only to further multiply by the number of degrees in the deflection angle.

A list to the practical man is sufficient.

Ferryburgh, Mich.

H. C. FRANKLIN.

Poisons and their Antidotes.
(For the Scientific American.)
BY G. J. ROSEWELL, M. D.

Fatal results of poisoning are most frequently occasioned by delay in applying, or by ignorance of, the antidote. The following is a list of the antidotes of the common poisons, and I suggest that chemists, druggists, and others who are brought daily in contact with poisonous substances, post this list in some conspicuous place in their laboratories.

For alkaloids, such as morphine, quinine, etc.: Emetics and the stomach pump must be relied upon rather than chemical agents. Astringent liquids may be administered, such as tannic acid, which precipitates many of the alkaloids from their aqueous solution, absorption of the poison being thus retarded.

For antimony (tartar emetic, etc.): Any form of tannic acid may be administered (infusion of tea, nutgalls, clonidine, and oak bark, or astringent solutions or tinctures), an insoluble tannate of antimony being formed. The stomach pump must be also applied as speedily as possible.

For arsenic (Paris green, etc.): Recently precipitated moist ferric hydrate, best administered in the form of a mixture of a solution of perchloride of iron with carbonate of soda. Emetics should be also given, and the stomach pump applied.

For copper (verdigris, etc.): For an antidote, administer iron filings, also white of an egg (albumen), which forms with copper a compound insoluble in water. Apply the stomach pump.

For hydrocyanic acid (cyanide of potassium, etc.): A mixture of green sulphate of iron, solution of perchloride of iron, and other magnesia or carbonate of soda, is the recognized antidote in cases of poisoning with prussic acid. Inhalation of ammonia is also advised.

For lead: Administer a solution of Epsom salts or alum, and induce vomiting.

For mercury (corrosive sublimate, etc.): Swallow the whites of several eggs. Albumen gives a white precipitate with salts of mercury, which is insoluble in the juices of the stomach.

For oxalic acid: In cases of poisoning with oxalic acid or salts of acrol, chalk and water may be administered as a chemical antidote, with the view of producing the insoluble oxalate of lime. Emetics should also be applied.

For strychnine: In cases of poisoning by this salt (Strychnine), solution of carbonate of ammonia should be given. White of egg is also said to form an insoluble precipitate with compounds of strychnine.

For strychnine: Large doses of castor oil, unfortunately, act as powerful emetics. If vomiting has not occurred, or has taken place apparently to an insufficient extent, a solution of carbonate of soda (common washing soda), immediately followed by white of eggs and dandelions, may be administered.

A NEW method, by Mr. Wilson, for lighting street gas lamps is as follows: The lamp has two burners; one, very small, burns all the time. When the gas pressure is raised, a small gas holder, on the top of the column, is elevated, affording a passage for the gas to the larger of the two tips, which is lighted by the small jet. Thus all the street lamps in the district may be lit automatically.

SNOW.—More snow has fallen on the Sierra Nevada mountains this present season than ever before known. This looks well for a prosperous season in the milling and agricultural industries of that region.

THE PROPOSED CHAMPLAIN SHIP CANAL.

By reference to the annexed map, the reader will be enabled to trace the extended route which it is proposed to open to commerce, by the construction of a ship canal and the improvement of the Hudson River between Troy, N. Y., and Whitehall on Lake Champlain. A perfectly feasible engineering work is contemplated, which, while inconsiderably small beside others of similar nature which have been completed throughout the world during recent years, nevertheless offers an official result of the highest importance to the North and Northwest of the United States, in that it provides undeniably the natural and best route from the Great Lakes to tide water.

From New York to Troy, a distance of 150 miles, the Hudson is navigable, as is well known, by vessels of large tonnage. From Troy to Fort Edward, a distance of forty miles,

average rate of eight miles per hour for steam vessels. From all the ports on the upper lakes to the foot of Lake Erie, all vessels whose cargoes are destined for tide water by any route will be upon equal terms. At that point Nature has presented a barrier, and here the products of the west take different routes to different markets. By the Champlain route a boat could come from Port Colborne, near the foot of Lake Erie, to tide water (without breaking bulk) in four days' time, allowing only the same rate of speed in the eighty-four miles of canal as are now made on the Erie canal, as against an average of at least ten days from Buffalo to Albany by the latter. This saving, of time and interest, of the expense of breaking bulk of transshipment and division of cargo, requires no argument to prove its importance. It is believed, moreover, that a canal adapted for a vessel of 1,000 tons—as it is proposed to construct that under consid-

Aniline Violet on Woolen Yarn.

One lb. of sulphate of magnesia is added to the box at a hand beat; the goods (10 lbs.) are moistened therein, and methyl violet is gradually added while the temperature is quickly brought to a boil. For dove color, dye as for violet, using only $\frac{1}{2}$ to $\frac{3}{4}$ oz. of color.

Madder Red, topped with Carmine, on Wool and Woolen Yarn.

One hundred lbs. of goods are boiled for an hour with 5 lbs. alum, 4 lbs. tin crystals, 5 lbs. tartar, $\frac{1}{2}$ lb. soda. They are then lifted and boiled for an hour in a fresh bath with 15 lbs. madder. Meantime 4 lbs. of green rockweed, 14 lbs. of tin crystals, and 1 lb. oxalic acid are boiled up, cooled, the wool entered, and boiled for an hour.

Arnold Miller prepares an oil mordant for Turkey reds with an emulsion of olive oil and a solution of glue. Into



there is an elevation of 116 feet to be overcome; from Fort Edward to the summit, a distance of two miles, an elevation of thirty-one feet; from the summit to Lake Champlain, at Whitehall, a distance of twenty-one and three tenths miles (seven miles of which is in Wood Creek), there is a descent of fifty feet to Lake Champlain. Thus it will be seen that the highest point between tide water and the St. Lawrence is 147 feet, and that the entire length of the river and canal improvement is but sixty-three and three tenths miles. Eleven locks and dams are required, the former to be 300 by 45 feet in size, to overcome the elevation and to give ten feet of water in the river. Wood's Creek, which runs into Lake Champlain, is already nearly ten feet in depth, and would require little straightening, so that the canal portion to be constructed is reduced to but seventeen miles, requiring but two locks. The width at the bottom is to be 110 feet and at the surface 150 feet.

The route from Whitehall extends up through Lake Champlain to the Richelieu river, and thence to St. John's, where the latter stream is entered by the projected Canajoharie canal. For this enterprise a charter has already been granted by the Canadian government, and work is to be speedily begun. The canal extends to Canajoharie upon the St. Lawrence river, and is twenty-nine miles in length. The country through which it passes is almost a dead level, there being a rise of but twenty-five feet, so that the entire work can be built in half cutting—that is, a cut of six feet and a bank of six feet would be all that would be required to construct a canal of 25 feet in depth. From Canajoharie the route continues, off the Beaulieu canal of eleven miles and the Cornwell canal of twelve miles (which canals are constructed around rapids in the St. Lawrence river, and which rapids are now being improved so that vessels on the downward course do not need to use the canals), through the St. Lawrence to Lake Ontario, and thence through that lake and the Welland canal (twenty-seven miles) to Lake Erie. From Lake Erie, vessels of any tonnage can pass into Lake Huron, Lake Michigan, and Georgian Bay; and, off theault Ste. Marie canal, of a little over one mile in length, vessels of 2,000 tons can pass from the waters of Lake Huron to Lake Superior. From Green Bay, an arm of Lake Michigan, there is now an improvement in process of construction which will, when completed, so improve the Fox and Wisconsin rivers that water communication will be opened between the Mississippi and Green Bay, a distance of 278 miles, and another already completed by the Illinois and Michigan canal and the Illinois river to the Mississippi river, a little above the mouth of the Missouri. Through this entire distance, from the lakes to tide water, with the exception of eighty-four miles of ship canal, there is, so far as speed is concerned, a free and unobstructed water way upon which steamers or sailing ships can be propelled at an

average rate of eight miles per hour for steam vessels. From all the ports on the upper lakes to the foot of Lake Erie, all vessels whose cargoes are destined for tide water by any route will be upon equal terms. At that point Nature has presented a barrier, and here the products of the west take different routes to different markets. By the Champlain route a boat could come from Port Colborne, near the foot of Lake Erie, to tide water (without breaking bulk) in four days' time, allowing only the same rate of speed in the eighty-four miles of canal as are now made on the Erie canal, as against an average of at least ten days from Buffalo to Albany by the latter. This saving, of time and interest, of the expense of breaking bulk of transshipment and division of cargo, requires no argument to prove its importance. It is believed, moreover, that a canal adapted for a vessel of 1,000 tons—as it is proposed to construct that under consid-

eration—will lessen the cost of transportation between the foot of Lake Erie and the Hudson river fifty per cent, a gain of two dollars per ton on the commerce of the west, or at least \$50,000,000 annually. The Canadian government is now contemplating the construction of a water way, known as the Ottawa and Lake Huron canal. This leads by a natural chain of rivers, as a glance at the map will show, from Georgian Bay to French river, thence through Lake Nipissing to Trent river, thence to the Ottawa, and thence to the St. Lawrence at Canajoharie. It would make a route of 300 miles from Chicago to Montreal against 1,340 miles by the St. Lawrence route, showing a saving of \$95 miles. This, therefore, when built, must tend to cut off comparatively the Erie canal and the Oswego canal from competition with the commerce over the Ottawa route, while the Champlain and Canajoharie canal would be in the direct line and would give New York all the advantages of the saving in distance. There are also local considerations which point to the advantages gained in the construction of the Champlain route. It would afford a highway and materially lessen the cost of transportation of the lumber manufactured in the Ottawa district, nearly 500,000,000 per annum; of the iron ore from Lake Champlain, 200,000 tons of which are yearly mined and shipped; of the products of the great fishing trade of Lakes Erie and Newfoundland, and also of the coal from Plover.

The bill before the New York legislature provides for the survey and location of the work at once, and calls for the raising of the necessary sum for its accomplishment, \$15,000,000, by suitable taxation.

NOTES ON DYEING.

(From Schenck's *Farber Leitung*.)
NICHOLSON BLUE ON CLOTH.

To 100 lbs. of material use 1 lb. color of the shade required; dissolve in boiling water, filter, and make up a dye bath with the addition of 4 lb. sulphate of zinc. In this the goods are worked for an hour, while the liquid is gradually raised in a bath of warm water at 120° F., containing 2 lb. sulphuric acid and 3 lb. sulphate of zinc. The dye consists of acids and soap.

NICHOLSON BLUE WITH A WOOD BOTTOM.

One hundred lbs. of woollen cloth are boiled for an hour with 1 lb. chromate of potash and 1 lb. of sulphuric acid, and allowed to cool in the liquid, lifted, rinsed, and dried in a fresh bath with 30 lbs. of oak wood. Two lbs. of Nicholson blue are now dissolved in boiling water, filtered and made up into a dye bath with the addition of 1 lb. of sulphate of zinc. In this bath the goods are boiled for two hours, lifted, rinsed and raised in a bath containing 6 lb. sulphuric acid and 3 lb. of sulphate of zinc.

this solution hypophosphite of soda is introduced, the finishing mass is allowed to stand two or three hours, and immediately used.—*Chemical News*.

Professor Thurston's Investigations on Metals.

Those of our readers who have already perused with interest the valuable papers contributed by Professor B. H. Thurston to these columns, relative to the strength, elasticity, etc., of materials of machine construction, will find the subject treated in extended form, and illustrated by a number of carefully prepared diagrams and engravings, in the recent published transactions of the American Society of Civil Engineers. Professor Thurston in the present issue offers still another communication on strains on metals, which will doubtless be read by mechanics generally with much profit.

A Chance for Investors.

A common, well built country wagon, weighing about 800 pounds, will carry 2,000 on any fair country road, and without injury pass over obstructions which cause it to fall one, two, or more inches, the paying weight being about 70 per cent of the whole. The ordinary box car in use upon our railways at the present time weighs about 10 tons; its maximum load is generally about 11 tons, while its average load is about 8 tons; the paying weight being from 44 to 52 per cent of the whole. It does not seem reasonable that the weight of a car constructed to run upon a smooth even track, without a ball, should be so disproportionately to the load carried. There is here a chance for investors to devise a light form of freight car, strong enough to carry 11 tons.

ARTIFICIAL COAL is made as follows: To two drums of vermicelli add one ounce of resin, and melt them together. Have ready the brancher twigs peeled and dried, and point them over with this mixture while hot. The twigs being covered, hold them over a gentle fire, turning them round till they are perfectly smooth. White coal may also be made with white lead, and black with lampblack mixed with resin.

A PATENT locomotive with twelve 8 feet 6 inches drivers and 15 by 20 inches cylinders, weighing 42 tons, made to burn either wood or coal, has lately been completed in England for the Mexican Railway. It is equipped with the Westinghouse brake, and also with the Le Chatelier counter pressure steam brake, which acts only on the locomotive. The engine is so work on a long grade of more than two hundred feet to the mile, and the boiler flues are inclined to suit this grade.

IMPROVED POTATO DIGGER.

The invention herewith illustrated is a simple and, it is claimed, efficient implement, by means of which the hills containing the potatoes are broken into furrows; and from the earth thus loosened, the potatoes are separated by suitably arranged clearing teeth. The apparatus is essentially an inside or under digger, and consists in a double mold board plow, A, which splits each hill or row in the middle into two opposite furrows, pushing the latter sufficiently outward and apart for the teeth, B, to act upon them from the inside, as so many little plows or coulters. The plow may be made to raise these furrows to any required angle. The teeth are constructed so as to have about the same inclination forward and outward as the mold boards, so as to enter and remain in the earth readily, in order to give a lifting cut against the furrows to a depth of from one to two inches, causing the dirt and potatoes to cave inward, and thus press against them. The potatoes, as they are loosened, fall into the spaces (about 3 or 4 inches) between the teeth, which, at the same time, break off the tendrils. The plow is made flat on top for the easier attachment of cleaver and beam, and their handier adjustment to the draft. The depth of furrow is regulated by the nuts and bolts at C, in connection with wedges or other suitable devices. The teeth may be made of wood or of round, square, or triangular rods of iron or steel, from 12 to 14 inches in length, slightly tapered from the under side of the frame downwards, and having any suitable form of point. They are firmly inserted in suitable holes or mortises in the arms. Their main object is to deal only with the roots of the vines, weeds, &c., as the points follow in the wake of the plowshares, which remove the principal obstacles from their way.

Draft is applied to the beam in the ordinary manner, as represented in the illustration. The inventor has also devised an ingenious form of gatherer, which is applied to the rear of the digger, and which serves to collect the potatoes into line or in bags as the implement advances.

Patented January 6, 1874. For further particulars address Mr. Hiram Smith, 28 6th street, Troy, N. Y., or his authorized agents in other localities.

REBER'S PORTABLE BLACKBOARD.

The accompanying illustration represents a rear view of a convenient and useful form of portable blackboard, which may be readily laid into any position, and raised to any suitable height. It may also be employed as a table, and when out of use may be folded into small compass so as to occupy but little room.

For teachers and others who have occasion to demonstrate graphically the subjects of instruction, or for engineers and architects who frequently need a handy surface to try the effect of a sketch or to work out a problem occurring during the course of a calculation, a device of this description will, without doubt, be found an excellent assistant. It will also prove useful in churches, Sunday schools, and, in brief, in any locality where wall boards are not at hand.

The standard, which, with the supporting legs, may be made of any desirable form or material, guides centrally a vertical rack, A, which is raised or lowered by theatchet, B, actuated by the crank shown, and held in any desired position by the pawl, C. To the upper end of this rack is secured, by means of a screw and thumb nut, a horizontal arm, D, one extremity of which is T shaped and hinged to the back of the board, while the other end is slotted and guides a bow-shaped lever, E. The latter is also hinged to the blackboard, as shown. By means of this arrangement the board may be readily placed at any desired inclination and so held by the thumb screw which binds lever, K, in the slot of arm, D. The movement of the former toward raising the table to a perpendicular position being limited by the projecting lugs at its lower end. The board is made in three pieces, the two outer leaves being hinged to the middle one so as to be readily folded. Levers, F, turning on bolts on the outer sections, secure the same rigidly by thumb screws, when placed, as shown in the engraving, in an extended position. The whole board turns easily on the rack. To reduce the apparatus to its smallest compass, the rack is lowered in the stand, the table placed horizontally, and the leaves folded down. It may then be rolled into a corner and used as a stand, or for any other convenient purpose.

Patented through the Scientific American Patent Agency, November 4, 1873. For further particulars regarding purchase of rights at wholesale or in sections of territory, address the inventor, Mr. James Reber, Noblesville, Pickaway county, Ohio.

Linolesine.

The activity of modern chemists is very remarkable, and has borne most important fruits. Among other useful work, they have studied almost every vegetable or animal substance that has any active properties, and have sought to isolate or separate their active principles. Thus the pungency of mustard, the exhilarating principles of tea and coffee, the narcotic of tobacco, the coloring essence of madder, and a countless multitude of other such active principles, have been separated and examined, and in many cases their elements have not only been discovered by analysis, but have been put together synthetically, and the active essence has been obtained from entirely new materials, even from sil-

It exists to the extent of about 80 percent in the best flaxseed oil, and has some remarkable properties. In its original state, as it exists in the fresh oil, it is a clear liquid, having the property of combining with oxygen and then solidifying without any decrease of bulk. This retention of its bulk is very important, and is one of the sources of its value to the painter. Colors may be ground into copal, mastic, or other varnishes, and when first used these form very brilliant medians; but varnishes are merely solutions of gums or gum resins in a volatile oil or spirit; and as they dry by the evaporation of the solvent, their bulk decreases, they shrink, and thus, if any considerable thickness is laid on at once, it displays this shrinkage by cracks. Artists who have been tempted by the brilliancy of a copal or other similar medium have had the vexation of seeing their pictures covered, after a year or two, with a network of cracks, and gradually becoming worthless. Hence the necessity, whenever varnish is used, of laying it on in a very thin film.

Another special merit of linolesine is that it solidifies into a remarkably tough substance, which does not become brittle by further drying. It also has sufficient elasticity to bear a considerable amount of bending. If a picture were painted with a varnish medium, and the canvas bent or rolled, it would crack most ruinously; but with a linolesine medium it will bear a considerable degree of such violence without suffering serious injury. Farther than this, linolesine is insoluble in alcohol, in turpentine, in petroleum spirit, in naphtha, and even in the bisulphide of carbon, which so effectively dissolves India rubber and many other stubborn substances of this class. This affords the great advantage of enabling the painter to go over the surface of his work with almost any kind of varnish. If the medium which holds his colors were soluble in the oil or spirit which serves as the solvent of the varnish, his picture would be smeared in the act of varnishing.

The work of the picture cleaner and restorer, and even of the humble housemaid in cleaning painted walls, depends upon this insolubility of the linolesine. Strong solvents may be used to remove the varnish and the adhering dirt, without attacking the picture itself, though in this work some care and skill are required, as even linolesine is not absolutely insoluble in all liquids. It happens, unfortunately, that the most convenient all cleaning agents, namely, soap, if it contains free alkali, as often is the case, will eat away and gradually remove this otherwise stubborn film which holds the painter's colors together, and thus we see that the persevering housemaid may, after many efforts, at last render visible the original woodwork of a painted wainscot or door. Every practical painter knows that the less turpentine and the more flaxseed oil he uses, the more durable is the coat of paint laid on. This depends on the fact that it is the oil and not the turpentine which contains the tough and nearly insoluble linolesine; the turpentine merely dilutes it, and renders the drying process somewhat more rapid.

The chemist has not yet succeeded in fully and practically separating this linolesine, but we may hope that he will do so. Ordinary boiled oil merely approximates to such separation, but we may hope some day to have a clear, bright, limpid, and colorless medium, consisting of the pure substance, and capable of being brought into the market at a practical price. At present such a thing is merely a chemical curiosity; but so many other useful things have been chemical curiosities first, and commercial commodities eventually, that we are justified in hoping some day to see linolesine in the columns of our price current.

—London Grocer.

Japan Lacquer.

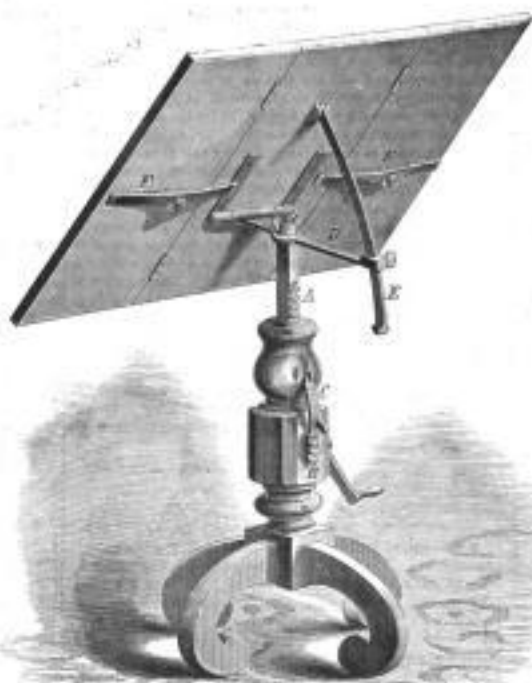
It has been generally supposed that the beauty of Japan lacquer work was due to ingredients derived from unknown plants, and that the secret was confined to the Oriental workmen. Recently, however, in Holland, objects of art have been produced, lacquered and covered with mother-of-pearl, in pieces indistinguishable from those made in Japan. The lacquer used is prepared from the hardest varieties of gum copal, principally that of Sumatra, which is colored black with India ink. The articles are covered with several layers of this substance, upon which, while still wet, or rather pasty, the mother-of-pearl is laid. Drying in a furnace follows, another coat of lacquer is applied, then more drying, and smoothing with pumice. These operations are repeated until the surfaces are perfectly united and smooth, when a final polish is given with tripoli.

COLORADO MINES.—The area of land known to be rich in gold deposits in Colorado is about 7,200 square miles, lying in various parts of the Territory, on both sides of the main range. There can be hardly a doubt but that this extent will be largely increased in coming years, for new discoveries are constantly being made upon the foot hills and plains.



STRAIT'S IMPROVED POTATO DIGGER.

wise useless or offensive refuse. Thus the modern chemist, not satisfied with superceding the coloring matter of the cochineal insect by the brilliant dye he has obtained from coal tar, has separated the dye essence, alizarine, from madder, has laboriously studied its chemical composition and relations, and, after years of investigation, has finally learned how to produce this also from the refuse of gas works. He will soon supersede altogether the cultivation of the madder plant, for his new product is not a mere imitation, but far better, because purer, than the original substance. In like



REBER'S PORTABLE BLACKBOARD.

manner he is now struggling with indigo; he has separated its active principle, and ere long will doubtless supersede the tropical plant by making indigo from house refuse.

Among such investigations is the search for the principle upon which the painter depends for the adhesion and drying of his colors. To this the name of linolesine has been given.

BYRON COIGNET ARTIFICIAL STONE FOR ORNAMENTAL ARCHITECTURE.

Some seventeen years ago, M. Coignet introduced his biton stone into France. Although at first encountering popular prejudice, the material speedily made its way, through its intrinsic merits, into favor, and finally, after being experimented upon for a period of two years, was adopted by the French government in the construction of many important edifices and structures. Forty miles of sewers in Paris, the immense aqueduct of Le Vaux, the arches of which cross the sandy valley of Fontainebleau for a distance of thirty-one miles, the supporting arches of the Exposition building, the docks at Bordeaux, and in various other prominent engineering works, the biton Coignet has been entirely employed; and also in Egypt the material has been used, for lighthouses and in forming the massive blocks used in the building of the Suez canal. In a large number of private and public edifices in the vicinity of this city, recently erected, this stone has been applied. Prominent instances among these are the arches, colonnades, and terraces of the great Roman Catholic cathedral, now in progress on the corner of Fifth avenue and 59th street, and in the various architectural ornamentations of Prospect Park, in the latter grand pleasure ground, a very beautiful arch, highly decorated, and the design of Mr. Calvert Vaux. This structure it was at first intended to build of granite and brick, but subsequently it was determined to make the whole of artificial stone, the material being especially advantageous for decorative purposes, as it offers great facilities for the reproduction of ornamental detail. A design, once well modeled and prepared for carving, can readily be repeated.

A large new manufactory of biton Coignet has been established by the New York and Long Island Coignet Stone Company; it is on Third avenue, between 54 and 6th streets, in Brooklyn, N. Y. The works are very extensive, covering an area of five acres, and are capable, we understand, of turning out fronts of ten ordinary houses per day, besides a large quantity of fine ornamental work, giving constant employment to some one hundred hands. The process of manufacturing consists in first grinding down the constituent elements of the stone to be imitated, and mixing them by machinery until they reach a plastic state. The molds are then filled by a peculiar process which entirely excludes the air, and are immediately removed. The stone, within a few days, is ready for transportation, and continues to increase in density.

The biton is impervious to water; and so far as experience proves, withstands the effect of frost or extreme northern climates, and will withstand a crushing pressure of about four tons to the square inch. Structures composed of it are much lighter than those of natural stone, while the strength is equal, if not, in many instances, greater. A cubic foot of

the material weighs about one hundred and forty-six pounds. Walls made of it present a homogeneous mass, and are not liable to the accidents common to brick and masonry structures.

We learn that, since the failure of both granite and marble in the great fires of Chicago and Boston, tests have been made as to the capability of biton Coignet to resist intense heat, and the results show that it neither explodes like granite, calcines like marble, nor warps and twists like iron structures. It is, besides, a non-conductor of heat to no small extent, and therefore tends to check the passage of conflagrations from building to building.

General Gillmore, of the U. S. Engineers, some time since visited Europe for the express purpose of inspecting the structures made from this stone, and on his recommendation the government has adopted it for use in the construction of the magazines, mally port, flooms, and other portions of Fort Wadsworth, on Staten Island. It would be difficult, we imagine, to limit the employments for which the material appears eminently suitable. As illustrated by Cliff Ridge Span, its peculiar character adapts it to the imitation of the most elaborate tracing and sculpture in the hardest stones; for by admixture of pigments, tiles of any color may be accurately reproduced. The cost of manufacturing is said to be about half that of natural stone when cut.

Photographic Engraving.

The subjects suitable for printing blocks, of the kind now to be described, are those known as line and dot subjects, that is, pen and ink sketches, line drawings, engravings, and such like, to the exclusion of objects in pure graduated tint, like a silver print from a negative of a natural subject having gradation of tint.

A plate of glass is coated with a solution of beeswax in ether, the relative proportions of the two being about half an ounce of wax to ten of ether. This leaves a very thin coating of wax upon the plate, which is still further attenuated by rubbing with a cloth. The object of this waxing is to prevent a too close adhesion of the gelatin coating, to be next applied.

To prepare the sensitive surface, gelatin is steeped in water for half an hour or upwards until it has become swollen from the absorption of water; most of the superfluous or unabsorbed water is now poured off, and the vessel containing the gelatin is placed in hot water, or otherwise subjected to heat, by which the gelatin immediately becomes liquefied. To this is added sufficient of a saturated solution of bichromate of potash to render it of an orange color, yet not sufficient to cause the salt to crystallize out and show itself upon the surface of a glass plate coated with the mixture. The film is dried and then removed from the glass, which is permitted to be done by the agency of the wax substratum. It is now ready for exposure.

Suppose, now, that a reproduction of an engraving or piece of ordinary print or sheet of music be the subject that is to be produced: a transparency—not a negative—of this subject must have been obtained and superimposed upon the side of the gelatin pellicle next to the glass plate. After exposure to light for a quarter of an hour—or more or less, according to the light and the quality of the negative—this gelatin film is pressed into contact with any handy flat surface, such as glass or metal, care being taken that the surface that was next the negative be placed outside. It is now sponged copiously with, or immersed in, cold water, by which a considerable amount of relief is obtained, the parts corresponding with the black of the original print or drawing being seen standing in high relief, while the whites are sunk. This, it will be seen, supplies the conditions for a surface block to print in connection with type, all that is now wanted being the conversion of the soft gelatin into hard unyielding metal.

The gelatin relief or mold obtained in the manner described is, first of all, made surface-dry by means of bibulous paper, and is then lightly dusted over with finely pulverized plumbago or bronze powder. A cast from this surface is then taken by means of molten beeswax, which, when cold, readily parts company with the gelatin relief, owing to the intervening sprinkling of plumbago or bronze. This wax cast is then sent to the electrotypist, who, in a few hours afterwards, will deliver a metallic cast, mounted upon wood and ready for working in the printing press. This process originated with Mr. Thomas West, of London.—*British Journal of Photography.*

Thallium.

The optical process of detecting thallium in a mineral is very simple, says Dr. Crookes. A few grains of the ore are crushed to a fine powder in an agate mortar, and a portion taken up on a moistened loop of platinum wire. Upon gradually introducing this into the outer edge of the flame of a Bunsen's gas burner and examining the light by means of a spectroscope, the characteristic green line will appear as a continuous glow, lasting from a few seconds to half a minute or more, according to the richness of the specimen. By employing an opaque screen in the eyepiece of the spectroscope to protect the eye from the glare of the sodium line, thallium may be detected in half a grain of mineral, when it is present only in the proportion of 1 to 500,000. The sensitiveness of this spectrum reaction is so great that no estimate can be arrived at respecting the probable amount of thallium present.

NEW HOT WATER FUNNEL.—This consists of a tin funnel, with a perforated rubber stopper in the neck, through which the glass funnel is passed; the whole is covered with thick felt; the space between the glass and tin funnel is filled with hot water.



THE CLIFF RIDGE SPAN, PROSPECT PARK, BROOKLYN.

Business and Personal.

The Charge for insertion under this head is \$1 a line.

For Sale very cheap—Cheap Center for clock which up to 100 lbs. R. F. Bop, No. 100, N. Y.

Wanted—To know the names of some party as partner who manufactured a machine to shave the hair of the head. T. H. Bop, No. 100, N. Y.

The "Little Monitor" Sewing Machine is the greatest improvement of the age. It is the only one that will sew without winding a shuttle three times of cotton. Asks women—G. L. Duane & Co., 200 Broadway, N. Y.

Wanted—Situation by a young Millwright in a Machine Shop. Address: P. O. Box 100, N. Y.

An experienced Mechanical Draftsman from Glasgow, wants employment. Address: R. F. Bop, No. 100, N. Y.

Lovell's Family Washing Machine Price \$10 a perfect success. Wanted for five years. Address: R. F. Bop, No. 100, N. Y.

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Brass Castings of superior quality. Send for prices to R. F. Bop, No. 100, N. Y.

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Little Giant Tack Hammer, Hammer and Puller Combined, makes every kind of work and child can use it. Send for details and copies of orders. S. H. Bop, No. 100, N. Y.

Wanted—A first class Machine, known among the makers as a "Washing Machine." Address: R. F. Bop, No. 100, N. Y.

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Patented Gold Press—The best in use. C. H. Bop, No. 100, N. Y.

Chemical, Drugs and more Minerals used by manufacturers, constantly on hand and sold by package and quantity to suit. L. & J. W. Fendler, New York.

Waterproof Enamelled Papers—all colors—for painting and other uses. Address: R. F. Bop, No. 100, N. Y.

Diagnosis and Carbon tubes and shaped for the purpose of the age. Address: R. F. Bop, No. 100, N. Y.

Fire Machinery Office—We believe that H. Bop's Office, No. 100, N. Y.

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E. S. asks: How is percussion printing for gas made? A. The principle of percussion printing for gas is to use a gas jet to heat a metal tube, which is heated by a gas jet.

R. E. W. asks: How can I construct an artificial light? A. Make artificial light by using a gas lamp with a glass globe and a gas jet. The gas jet is made of a metal tube, which is heated by a gas jet.

W. H. B. asks: In the use of any kind of solution by which water and waste may be filtered by passing them through a ball, or well as in the ordinary way of filtering with sand or gravel? A. Yes, by means of chlorine.

M. M. asks: Is there any gas that I can use for fuel in a chemical laboratory? A. Yes, hydrogen gas is used for fuel in a chemical laboratory.

G. G. asks: Can you give me a good recipe for making a good solution? A. Yes, by means of chlorine.

E. D. E. asks: Has the government or any other body a patent for making a gas? A. Yes, the government has a patent for making a gas.

W. H. C. asks: 1. What are the best for fuel? A. The best for fuel are coal, oil, and gas.

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